Method and device for connecting plates lying on t p of one another

The invention develops from a method and/or a device for connecting plates lying on top of one another according to the clinching process of the generic principal claim and the secondary claim 8.

Two methods and/or devices are known for clinching i.e. for once a die without a cutting part and on the other hand a die with such a cutting part. The cutting part separates the deep-drawn plate section in portions from the plate, where it was drawn from. During the non-cutting clinching the deep-drawn plate sections flow during the squeezing radial outwards, like snap fasteners, and sub-seize the plates. Particularly then, if a connection from plates of different hardness or materials takes place, different stresses result from the different consistency, which can be a disadvantage for the connection. On the one hand a certain weakening results through the deep-drawing and the therefore occurring thinning of the material, on the other hand a spike-connection of the material results through the sub-seizing, what represents the actual connection.

With a well-known connection (DE-OS 35 32 899) plate pieces lying on top of each other are punched by punching cams along a part of their outlining lines and are deep-drawn from the plate plane, after which, by means of the die and a back pressure area in the bottom die, the plate section closer to the plates is widened by squeezing and sub-seizes the first plate. Apart from the fact that an unretentive spot within the area of the connection results in the plate, such a punching procedure causes a substantial reduction of the strength, which does not occur with another well-known generic clinching process (EP-PS 0,215,449), with which the plate sections are deep-drawn by the die into a deep-drawing opening and are afterwards squeezed wide. This results in an extremely actuated and positive locking joint point, which however again can lead to connecting problems with different materials of the plates, as aforementioned above. During such a snap-fastener-like connection the spike-connection is simply not as strong as with the unilateral punching cam. In order to accommodate for that, there are known clinching processes (PCT/EP 96/0305, WO 97/02912), in which the side walls of the deep-drawing opening are designed flexible, so that after the deep-drawing procedure desired clearances result for the squeezing procedure. Apart from the fact that due to the lacking radial resistance an actuated interlinking of the displaced and sub-seized materials cannot take place, by which clearances causing a loosening would be filled, tensions caused by the axially symmetrical radial expansion remain in the connecting point, which are not reduced however, which likewise depends on the radial yielding of the walls of the deep-drawing opening and which happens at the expense of the strength of the connecting point.

The method of the invention according to the principal claim, and/or the device of the invention for the working of the method according to the secondary claim 8, has in contrast to this the benefit that plates of different materials can be connected with high strength. So also plates from metal and plastic can be connected, with sufficient durability. It is particularly favorable that due to the different deformation in two cross directions of the plate sections a relatively strong material displacement takes place in the first cross direction and their transitions to the second cross direction with corresponding strong sub-seizing of the plates by

the plate sections, however at the of the thickness and also the strength of the wall parts. Whereas in the second cross direction due to the wedge form of the die fewer material is displaced and so that the connecting neck between the bases of the plate sections and the plates is relatively thick and thus very firmly designed. Since the transition between these two extremes is flexible, the strong neck of the wall parts in the second cross direction works itself and the strong sub-seizing by the plate sections in the first cross direction in combination result in a total improvement of the connection, for example also compared with all other well-known clinching connections.

After a favorable embodiment of the method according to the invention the die and the deep-drawing opening exhibit a circular cross-section or an oval cross section and the work area of the die is designed wedge-shaped with an essentially rectangular front surface, so that at the opposite sides of the die strong thinning up to tear separation of the wall parts of the second and additional plate sections take place, so that the radial displacement is held back by the wedge areas.

After a further favorable embodiment of the invention the volume of the deep-drawing opening is constant in the press direction and transverse to the press direction, so that during the squeezing procedure the longitudinal extension as well as the transverse extension of the deep-drawn plate sections is limited unyieldingly and an edge area, running in deep-drawing direction, results (EP 0,215,449).

After a further favorable embodiment of the invention the volume of the deep-drawing opening can be increased in longitudinal extension and/or transverse extension (DE-GM 297 00 868, WO 97/02912).

After a further favorable embodiment of the invention existing edges of recesses, pointing towards the plate section, engage during the squeezing procedure at the base of the deep-drawing opening in the first plate section and obstruct the radial outward flow of the material, whereby displaced material from the second or above plate section flows into the resulting radial clearances.

After a further favorable embodiment of the invention the obstruction of the radial outward flows takes place in the first cross direction. The edges obstructing the radial outward flow can of course run also in other directions, if this is of advantage for the inventive procedure.

After a further favorable embodiment of the invention the first and third plate can consist of metal and the second plate lying between them can consist of plastic. Such material combinations could so far not be connected satisfactory in a clinching process, since the soft intermediate material prevented the required form-fit and grip.

After an embodiment of the invention concerning the device according to claim 8 the die above the wedge shape and the deep-drawing opening exhibits a circular or oval cross section.

After a further favorable embodiment of the invention the deep-drawing opening in the bottom die is designed in radial and axial direction as a blind opening, whose side walls run in

direction of movement of the die and are unyielding, like the bottom plane of the deep-drawing opening.

After an alternative favorable embodiment of the invention the side walls of the deep-drawing opening are radially flexibly designed, which can be achieved by an elastic medium.

After a further favorable embodiment of the invention the base of the deep-drawing opening, although actually unyielding, can be adjusted a certain stroke length when exceeding a certain pressing force of the die.

After a further favorable embodiment of the invention a recess is provided in the base of the deep-drawing opening, whereby the recess exhibits edges towards the bottom plane, which fit into the plate section after the deep-drawing, in order to obstruct thereby the radial flow of material during the squeezing procedure, what in turn creates clearances, into which the material of the second or above plate sections can flow.

After a further favorable embodiment of the invention the recesses are designed as concentric or central symmetrical key grooves, which are arranged continuously and/or misaligned to each other.

Further benefits and favorable embodiments of the invention can be taken from the following description of the drawing and the claims.

A design example of the subject of the invention is represented in the drawing and is following described in more detail. Shown are:

Figure 1 a tool unit, including plates, before their processing
Figure 2 a view in accordance with arrow II in figure 1
Figure 3 a section in accordance with arrow III in figure 1
Figure 4 a section through a finished connection point, according to the tool position in figure 1, but in different scale and
Figure 5 a section through a finished connection point in accordance with figure 4, however it is rotated 90°.

In Figure 1 a die 1 is shown in its side view, which exhibits a work peg 2 and a retention shank 3, each having a circular cross section, as it also can be seen in Figure 2. The peg 2 exhibits a front surface 4 and flattenings 5, what creates kind of a wedge shape. As it can be seen in Figure 2, the front surface 4 creates together with the lateral surface 6 of the peg 2 deep-drawing edges 7. In Figure 1 only the front edge can be seen. This die is located in a press with a tool holder, in order to be able to accomplish a force stroke in direction of the arrow I, what is not shown in detail.

Underneath the die 1 a bottom die 8 is located in the press, with a deep-drawing opening 9, with firm radial walls 10 and a likewise immovable base 11. Between base 11 and wall 10 a circular groove 12 is provided. In the base itself a recess in the shape of a key groove 13 is located, which exhibits edges 14 towards the bottom space. In the section through the bottom

die shown in figure 3, it can be seen clearly that this key groove 13 leads into the circular groove 12 at its two ends.

Three plates are put on the bottom die 8, i.e. two metal plates 15 and 17 and a plastic plate 16 arranged between them. In order to create a connection according to the invention between the three plates 15, 16 and 17, the die 1 is driven downward in the direction of the arrow 1, whereby it deep-draws in the first part of its operating cycle the three plates 15, 16 and 17 into the deep-drawing opening 9, until the first lower plate 15 touches the base 11. After this, due to the resulting resistance and the continued pressing power, the three plates are squeezed together. During this squeezing procedure the first plate 15 is pressed into the key groove 13, so that thereby the flow process is obstructed radial outward. The squeezed material thus flows primarily in direction of the serration, instead of crosswise to it. The plate sections of the plates 16 and 17, which are drawn into the deep-drawing opening 9 during the deep-drawing procedure, are thinned and, if necessary, separated in the corresponding places by the edges 7 of the die 1, while in the places, where the flattenings 5 are in effect, these improve the squeezing procedure transverse to their course.

In figure 4 a section through a finished connection point is shown, which corresponds to the represented position of the die 1.

In Figure 5 a section through the same connection point is shown, however it is rotated 90°, i.e. that here splittings 18 on the inside of the point are created by the deep-drawing edges 7. During this separation process the first plate 15 is not affected according to the invention. As it can be seen in Figure 5, the deep-drawn and squeezed plate section 19 belonging to the plate 15 shows elevations 20, created by the circular groove 12 and the key groove 13. The plate section 21 of the plate 16, consisting of plastic, and the plate section 22 of the third plate 17 are partially separated from each other by the deep-drawing edges, according to the section in Figure 5, while in the other, 90° rotated position, these plate sections 19, 21 and 22 are still fully connected with the plates 15, 16, 17.

All features represented in the description, the following claims and the drawing can be substantial for the invention both individually and in arbitrary combination with one another.

Reference number list

1 Die
2 Work peg
3 Retention shank
4 Front surface
5 Flattenings
6 Lateral surface
7 Deep-drawing edges
8 Bottom die
9 Deep-drawing opening
10 Side walls
11 Base
12 Circular groove
13 Key groove
14 Edges
15 Metal plate
16 Plastic plate
17 Metal plate
18 Splitting
19 Plate section
20 Elevations
21 Plate section
22 Plate section